In Vitro Evaluation of the Cleansing Working Time and Analysis of the Amount of Gutta-Percha or Resilon Remnants in the Root Canal Walls after Instrumentation for Endodontic Retreatment

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Abstract

The present study assessed the obturation removal and reinstrumentation working time of canals filled with Resilon/Real Seal in comparison with canals filled with gutta-percha/AH Plus. Thirty human extracted canines were instrumented. In group 1 (n = 15) root canals were filled with Resilon/Real Seal and in group 2 (n = 15) with gutta-percha/AH Plus sealer. The obturations were removed from both by using chloroform and irrigation with 2.5% NaOCl, and the canals were manually reinstrumented. The teeth were radiographically analyzed. Specimens without obturation material remnants visible in the radiographic examination were selected for analysis under scanning electron microscopy. The Resilon/Real Seal system was removed in greater quantities from the canal walls compared with the gutta-percha cones and the AH Plus cement. Time was not a significant factor. Under scanning electron microscopy analysis, the teeth presented material remnants in the 3 analyzed thirds. Resilon was better removed from the canal than the gutta-percha cones and the AH Plus. *(J Endod 2007;33:1426–1428)*

Key Words

Endodontic retreatment, endodontics, Resilon

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Proper sealing of the root canal system is required to maintain the disinfection obtained after cleaning and shaping, which facilitates the repair process of the periapical tissues. Correct preparation of the root canal system will not suffice if the obturation is not done hermetically, thus preventing recontamination and consequent failure of the endodontic therapy (1).

Gutta-percha is an organic substance that, combined with endodontic sealers, is the most widely used material for root canal filling. However, Resilon (Pentron Clinical Technologies, Wallingford, CT), a recently introduced material designed to prevent crown microleakage, has been developed as an alternative to gutta-percha (2, 3). Resilon is a thermoplastic synthetic polymer (polyester) compound that contains bioactive glass, bismuth oxychloride, and barium sulfate (4). Moreover, it has the advantage of using adhesive materials that can reduce apical and coronary microleakage of the root canal system (5–8). The Resilon/Real Seal system induces a chemical interaction that leads to the formation of a single resin block, which adheres to the root canal walls.

Despite the high success rates of the endodontic treatment, the clinician should be prepared to retreat the root canal system if endodontic treatment fails (9), which can only be done effectively if the obturation material is completely removed. However, few studies have evaluated the removal of Resilon and the amount of residue remaining inside the canal after removal (10–13).

Hence, the present study assessed the obturation removal and reinstrumentation working times and the cleansing thoroughness of canals filled with Resilon/Real Seal system in comparison with canals filled with gutta-percha cones and AH Plus sealer. In addition, the experimental specimens that did not present remnants of obturation material were observed under a scanning electron microscope (SEM), and the radiographic findings were compared.

Material and Methods

Tooth Selection and Preparation

Thirty human single-rooted extracted canines, completely formed with patent apex, were provided by the Tooth Bank of São Leopoldo Mandic Dental Research Center, Campinas, SP, Brazil.

The dental crowns were removed with a diamond point so that all teeth would have an average length of 17 mm. The working length (WL) was determined visually with a #15 K-file, and 1 mm was subtracted.

The teeth were embedded in blue acrylic resin (group 1, n = 15) or in transparent acrylic resin (group 2, n = 15), forming a square block whose sides were aligned with the buccal, lingual, mesial, and distal aspects of the teeth.

Cleaning and Shaping

The teeth were instrumented following the crown-down technique with Gates-Glidden burrs #4, #3, and #2 and with Kerr-type manual files up to a master apical file equivalent to #40. The step-back procedure was performed in a programmed manner,

withdrawing 1 mm up to file #55. Each tooth was irrigated with 30 mL of 2.5% NaOCl. Then, 17% ethylenediaminetetraacetic acid was used, followed by 5 mL of 2.5% NaOCl to remove the organic portion. In group 1 (specimens 1–15), in which all canals were obturated with Resilon cones and a resin-based cement, the root canal was irrigated at the end with 10 mL of 17% ethylenediaminetetraacetic acid and 10 mL of distilled water to remove any NaOCl residues because of their interference with the resin polymerization quality (14). After instrumentation, the canals were dried with #40 absorbent paper points.

Obturation of the Root Canal System

In group 1 the selected primary cone was the #40, with taper .04 (Dentsply/Maillefer, Ballaigues, Switzerland). A layer of self-curing primer was applied with a #40 paper cone inside the root canal, and excess material was removed with a dry #40 paper cone. Then the primary cone, coated Real Seal sealer, was introduced to initially spread the sealer on the canal walls. Selected finger spreaders were used, with light apical pressure up to 2 mm short of the WL. Then, accessory F cones coated with sealer were introduced into the canal until complete root canal filling. Excess cones were cut, and the obturation mass was vertically condensed. Light-curing was performed for 40 seconds, and the tooth was sealed with temporary cement.

In group 2 the primary cone selected was the #40, with taper .04 (Dentsply/Maillefer). The primary cone, coated with filling resin cement AH Plus, was introduced to initially spread the cement on all the root canal walls. Obturation followed with finger spreaders and accessory cones coated with cement until completely filling the root canal, as in group 1. The obturation mass was condensed vertically. The teeth were sealed with temporary cement and were radiographed with an exposure time of 0.4 seconds at a fixed focal distance of 15 cm in the mesiodistal and buccolingual directions. The specimens were stored in a kiln at 37°C at relative humidity for 30 days.

Obturation Removal and Cleansing of the Root Canal

The obturations were removed from the canals of both groups, and the canals were reinstrumented following the same technique. A drop of chloroform was used to initiate the obturation removal process. Then, 28-mm Gates-Glidden burrs, numbers 4, 3, and 2, were used in this order to remove the obturation from the middle and cervical portions. Another drop of chloroform was introduced to dissolve the obturation mass in the apical portion. Afterwards, a #25 K-file was used to initiate the removal of the obturation from the apical portion, with clockwise, quarter of a turn, apical pressure movements. This movement was repeated until WL was reached. The files were applied in increasing order up to 2 files above the initial surgical diameter, ie, up to Kerr file #50. A programmed 1-mm step-back procedure was performed up to Kerr file #70. The entire procedure was complemented by irrigation with 2.5% sodium hypochlorite.

The obturation removal and cleansing procedures were considered completed when no obturation material was observed inside the canal under an optical microscope with 12.5× magnification.

The working time of the procedures was measured with a digital chronometer set at the beginning of the obturation removal process and stopped at the end of the reinstrumentation. The reinstrumentation working time for each tooth was recorded and tabulated.

TABLE 1. Means and Standard Deviations of the Working Times (min) for the Reinstrumentation of Groups 1 and 2

Group	N	Mean	Standard Deviation
1	15	10.48 [a]	0.76
2	15	10.36 [a]	0.77

Means with similar letters do not differ from each other at the 5% significance level.

After reinstrumentation the teeth were radiographed in the buccolingual (BL) and mesiodistal (MD) directions at a fixed focal distance of 15 cm.

The images were processed, digitalized, and analyzed with AutoCAD software, version 2006 (Autodesk, San Rafael, CA). The areas of the canal and remnants of obturation material were calculated in mm^2, and the values were carefully recorded and tabulated.

After image analysis, the specimens that did not show remnants of obturation material observed in the radiographic examination in the 2 directions that were analyzed would be selected for internal root surface analysis under SEM. The cervical, middle, and apical thirds were observed at 30× magnification.

TABLE 2. Means and Standard Deviations of the Radiographic Analysis in the MD and BL Assessments

	Group	N	Mean	Standard Deviation
MD assessment	1	15	0.64 [b]	0.72
MD assessment	2	15	3.53 [a]	4.05
BL assessment	1	15	1.06 [b]	1.34
BL assessment	2	15	7.55 [a]	8.25

Means with similar letters do not differ from each other at the 5% significance level.

Results

Time Analysis

The mean times obtained (in minutes) were analyzed by one-way analysis of variance, which revealed no significant statistical difference between the real-time means for retreating the teeth obturated with the Resilon/Real Seal system and for retreating the teeth obturated with gutta-percha/AH Plus ($P > .10$) (Table 1).

Radiographic Analysis

Wilcoxon rank sum test was applied for radiographic analysis. The results are shown in Table 2.

In the MD assessment, the mean obturation material remnant value was significantly higher in group 2 than in group 1 ($P < .01$). In the BL assessment, there was significantly more remnant material in group 2 than in group 1.

Specimens 1, 6, 10, and 11 from group 1 did not present remnants of obturation material that could be radiographically observed in both directions (BL and MD).

SEM Analysis

The SEM analysis at 30× magnification of the specimens 1, 6, 10, and 11 revealed remnants of obturation material in the 3 thirds studied.

Discussion

The success of endodontic retreatment is directly related to the complete removal of the obturation material from the root canal. Numerous techniques have been proposed to remove the obturation from the canal system, including the use of manual files, rotary instruments, Gates-Glidden burrs, heat, ultrasound, and use of adjunctive solvents (9, 11, 15–17).

The obturation removal technique used in this study was manual. Other systems showed results similar to manual instruments in terms of cleansing ability during endodontic retreatment (8, 16). Chloroform was chosen to help remove the obturation because it allows quicker access to the WL and helps to maintain the original route of the canal by facilitating instrumentation inside the obturation mass (11, 15).

In the present study, an operating microscope was used after reinstrumentation to visualize the cleansing of the canal walls according to Schirrmeister et al (13). Even though some obturation material remnants were visible in some areas of the canal walls, their removal was extremely difficult, which goes along with the findings of Schirrmeister et al (12).

When the obturated roots were radiographically evaluated in the MD direction, remnants of obturation material were found in both groups, although a significantly greater amount was observed in group 2 than in group 1. In the BL direction, similar conditions were observed, ie, group 2 presented significantly more obturation residues than group 1, which confirms the studies of Ezie et al (11) and Schirrmeister et al (12), in which canals obturated with Resilon cones presented cleaner walls at the end of the obturation removal procedure. Oliveira et al (10), working with rotary instrumentation, obtained the same result after studying canals obturated with Resilon.

The difference in effective removal of the 2 groups of materials might be explained by the formation of a single block, as described by Teixeira et al (18), considering that the Resilon/Real Seal system will detach from the canal walls as a whole, facilitating its removal.

The apparent absence of material on the radiographic analysis prompted a more detailed examination by SEM analysis. Evidently, radiographic examination has limited application in detecting the presence of residual material after obturation removal and reinstrumentation procedures in the root canal system. However, Carvalho-Junior et al (19) found that Resilon, AH-Plus, gutta-percha, and Epiphany presented similar radiopacity results, which were above the 3 mm of aluminum recommended by American National Standards Institute/American Dental Association Specification 57, supporting the criteria used in this study for specimen selection for SEM analysis. The challenge here is that in daily clinical practice, although the operating microscope is very helpful, the dentist can only resort to the visual and radiographic analysis to evaluate the cleansing thoroughness of canals following retreatment procedures.

The working time here indicated that there was no significant statistical difference between the 2 groups analyzed, which is in accordance with the study by Schirrmeister et al (12) but contradicts the study of Oliveira et al (10). In the latter, the group obturated with the Resilon system presented quicker removal than the group obturated with gutta-percha. The mean times observed for groups 1 and 2 in the present study, although greater than those observed by Ezie et al (11), might still be considered relatively short working times. The reason for these differences might be explained by the different techniques used for material removal. Both studies (10, 11) used rotatory system, whereas the present study removed the obturation material by hand instrumentation.

In conclusion, Resilon/Real Seal system was better removed from the canal walls than the gutta-percha cones and the AH Plus cement. Under the SEM, the teeth presented obturation material remnants in the 3 analyzed thirds, despite the absence of observable material in the radiographic image. If the material removal is well-executed, it will provide access to the root canal system and allow the objectives of the endodontic therapy to be attained.

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